

Miscellaneous Report No. 37

AERIAL BRUSH CONTROL IN LAKE STATES FORESTS

by

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FOREST SERVICE  
Lake States Forest Experiment Station

1955

March 1955

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One of the most striking advances in forest management since World War II has been the development of less laborious and faster methods of controlling brush and other woody plants that interfere with the growth of the crop trees. These consist of treating the competing vegetation with chemicals known as herbicides which kill or set back the weedy growth and at the same time do little or no harm to the desirable species. Although other types of application have since been worked out, the first approach--applying these herbicides in foliage sprays during the growing season--is still the most popular one.

Because of the ready adaptability of farm and orchard spraying rigs, and also their availability, these have naturally been the most common equipment used for foliage spraying. Thousands of acres, particularly along roads and utility lines, have been and are being satisfactorily sprayed with such sprayers. However, in forest brush control, owing in part to the inaccessibility of the brushy areas and in part to the height of the competing vegetation, foliage spraying with such ground equipment has been less important than some of the other methods of applying herbicides.

But this situation seems to be due for a change. Pioneer tests of foliage spraying of brush from aircraft on range land in Oklahoma 2/ have encouraged forest managers to try out the feasibility of such spraying on forest land. These trials indicate that sufficient kill can be obtained to do a satisfactory job at a cost considerably lower both in time and money than hand labor. Consequently, although much research is still needed, many forest managers are proceeding with aerial spraying on more than a trial basis. They reason that even if a second application is needed to give the desired results, it is still cheaper than hand work. Furthermore, they feel that their experience will help supply the information needed.

1/ Maintained at St. Paul 1, Minnesota, by the U. S. Department of Agriculture, Forest Service, in cooperation with the University of Minnesota.

2/ McIlvain, E. H., and Savage, D. A. 1948. Range improvement through sagebrush control with 2,4-D in the southern great plains. Fifth annual research report, North Central Weed Control Conference, Project VI, No. 7.

In view of the great interest in aerial brush control among foresters and other wildland managers, it seems worthwhile to summarize in this paper the early trials of aerial spraying in the Lake States and the advantages and disadvantages of this operation as they appear at present. Also discussed are some of the purposes for which this promising technique of application can likely be used.

#### EARLY TRIALS IN THE LAKE STATES

In the summer of 1951 a few foresters got together with men representing the airplane sprayers and the chemical industry and planned some cooperative small-scale tests of aerial brush control in Minnesota. <sup>3/</sup> The outcome was a total of 20 acres sprayed from the air in the latter part of August of that year, part of it lowland brush and part upland species. A kill of 70 to 90 percent of the brush was obtained in each area, using from 1 to 4 gallons of solution per acre. The results were thus comparable to ground spraying using 80 to 100 gallons of solution. Resprouting occurred but was no greater than that following any foliage spraying done that late in the growing season.

This was followed in 1952 by a small test of aerial spraying to release planted red pine on the Manistee National Forest. Here, two 4-acre plots of low-grade oaks, up to 50 feet in height and a foot in diameter, were sprayed in late August using 1 pound of 2,4,5-T on the first plot and 2 pounds on the second plot in 5 gallons of solution per acre. An examination this past summer (2 years later) showed that 90 percent of these trees were defoliated. The remainder had live foliage on the lower branches but this appeared to be dying. As a result, the planted pines had been completely released.

As word got around about the success of these small trials, a great deal of interest in brush control by aerial spraying was aroused among the foresters of the Lake States. This is well shown by the increasing amount of forest land being sprayed from the air in the region. In the summer of 1952 some 620 acres were treated in Michigan, and in 1953 almost 1,100 additional acres were covered, partly in Michigan and partly in Minnesota. The total in 1954 was about 5,400 acres, some land being so sprayed in each of the three Lake States. Agencies doing this work include: The National Forests in Michigan, Wisconsin, and Minnesota; the Game Division of the Michigan Conservation Department; the Northwest Paper Company; the Minnesota Division of Forestry; and the Kimberly-Clark Corporation.

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<sup>3/</sup> Cooperators were Lake States Forest Experiment Station; Division of Forestry, Minnesota Conservation Department; School of Forestry, University of Minnesota; Minnesota and Ontario Paper Company; Northwest Paper Company; Minnesota Airport Operators Association; and Dow Chemical Company.

Fortunately, the results of most of these large-scale jobs have been encouraging. A good example is a 500-acre tract of scrubby oaks on the Huron National Forest which was sprayed in mid-August 1953 with 1 pound of 2,4,5-T in  $2\frac{1}{2}$  gallons of solution per acre. In 1954, 1 year after spraying, the oak overstory was found to be better than 90 percent defoliated; an excellent job of release had thus been done. 4/

Trial-and-error spraying of this kind, however, can conceivably result in costly failures, hence it is only good business for any agency contemplating such work to make sure it has all the information available on the species it is desired to control. For example, it would seem better not to spray large areas of aspen until more is learned about the reasons for the erratic results which are being obtained with this important species.

#### ADVANTAGES AND DISADVANTAGES

Although the main advantages of aerial spraying with herbicides--its speed and its relatively low cost--have already been indicated, this method has one other important advantage which also should be stressed. This is its ready applicability to areas which cannot be sprayed from the ground either because the brush is too tall or too dense or because the area is inaccessible to ground equipment by virtue of remoteness of its location or the roughness of the terrain.

The chief disadvantage is, of course, the problem of drift. Because of this, aerial spraying must be restricted to weather which is practically calm (quite a rarity in some years) and to tracts where there is no chance of injuring desirable stands or crops on adjacent land. In areas where forest land is a checkerboard of diverse ownership, it may be impossible to use this method.

Another disadvantage is the fact that spraying with conventional aircraft is not feasible on tracts of irregular outline, mainly because it is difficult to keep the treated swaths within the area to be sprayed. Consequently, in such cases, land will be sprayed that does not need it.

Third, aerial spraying in such jobs as high plantation release may give more kill of the overstory than may be necessary or even desirable. In hand release one can, of course, spare any hardwoods which are not actually interfering with the planted trees, but this is not true of aerial spraying. Since such hardwoods may serve as trainers for nearby conifers and also can supply an intermediate crop of wood, their complete elimination may not be desirable.

4/ Ralston, R. A., and Coulter, L. L. 1954. Aerial spray tests with 2,4,5-T for scrub oak control in Lower Michigan. Lake States Forest Experiment Station Technical Note 424, 1 p.  
(Processed)

In deciding whether or not to use aerial spraying for a given job of brush control, the land manager should carefully weigh these disadvantages against the more obvious advantages.

## POSSIBLE USES OF AERIAL SPRAYING IN FOREST MANAGEMENT

Although there is considerable room for improvement in application techniques, such as flight patterns, time schedules, area marking, etc., much progress has been made in adapting this modern method of applying herbicides to forest brush control jobs. Because of the generally larger vegetation involved and the consequently greater height at which the aircraft must fly, such spraying will likely never do quite as uniform a job of control as that of agricultural crops. However, this is not necessary, for in most of this work all that is needed is to tip the ecological balance just enough to favor the crop trees rather than to kill their competitors completely. In other words, if the undesirable species can be given enough of a setback so that the favored trees will win out in the competition for dominance, this will usually be sufficient. Consequently, some of the jobs that will be acceptable to the forester may look rather poor to the layman. Such lower standards will, of course, be accompanied by lower costs.

Of the various jobs for which foresters in the Lake States are using aerial spraying to control brush, the most important has been plantation release. Others are the preparation of brushy land for planting; killing brush and unwanted overtopping hardwoods to encourage natural reproduction of conifers (this both in swamps and on high land); and the opening up of low-grade aspen stands to improve the range of game birds and animals. Of potential importance is spraying in conjunction with the underplanting of low-quality aspen with red pine.

### Plantation Release

The planting of forest land denuded by logging, fires, or unwise farming or a combination of these has been of very great importance in the Lake States. Beginning on an appreciable scale in the 1920's, the planting of the conifers, pine and spruce, was later given a great impetus, lasting until the war years, by the Civilian Conservation Corps. Since that time a much smaller amount of planting has been done. It is still an important activity, however, and if the swamp planting now being tested is successful, it will likely become of even greater importance. All told, some 1,920,000 acres have been planted in the Lake States. Unfortunately, about one-fourth of this area has been lost, partly because of fire and insects but mainly due to lack of plantation care.

Contrary to common belief, plantation establishment consists of a lot more than putting the trees in the ground. Forest plantations, like the common farm crops, also have weed enemies, and failure to control them is just as serious as it is in the cornfield.

Neglect of these weeds can result in the complete loss of the planted conifers or, at best, in a great reduction in their growth. On most areas, therefore, planting is only the first step in plantation establishment. The second is control of the weeds, especially shrubs and the suckers or sprouts of such broadleaf trees as aspen, birch, and oak. Herbs, too, sometimes should be removed. The control of such plants is commonly known to the forester as plantation release.

Plantation release is of two general types, low release and high release, depending on the size of the vegetation interfering with the planted trees. Low release is commonly done within 3 to 5 years after planting. If the job is well done, the conifers will grow rapidly and get ahead of the brush so that the more expensive high release will not be needed. Most of the large area now needing high release is the direct result of the insufficient amount of labor and funds available to do this work during and after the war.

Until a couple of years ago, when the possibilities of aerial spraying became evident, practically all plantation release was done with hand labor. Power saws had come into limited use in high release but, in the main, hand cutting with axes or other edged tools was the rule. In addition to being time-consuming, hand work is very costly, varying from \$13 to \$25 per acre depending on the degree of cover removed. The discovery that foliage spraying with chemicals could be used effectively to kill back the brush without harming the planted trees was, therefore, of great interest to those responsible for plantation care. However, due either to the large size of the trees, inaccessibility, or rough terrain, it was impracticable to spray-release many plantations from the ground. Power spraying was, of course, much more rapid, but the equipment required often made the cost about as high as that of hand spraying.

The substitution of aircraft for ground equipment in foliage spraying, however, seems to offer an easier and cheaper method of plantation release. Not only can large areas of plantations be released in a very short period of time, but also this job is being done at a cost much lower than believed possible a few years ago. For example, during the 9-day period, August 9 to 17, 1954, some 2,000 acres of pine plantations overtapped by a growth of scrubby oak on the Lower Michigan National Forest were sprayed at a cost of less than \$2.50 per acre. No results are, of course, available from this job, but by the end of August the oak leaves were brown enough to show that coverage had been good. Release of this area by hand methods would have required around 2,500 man-days of labor and would have cost about \$13 per acre.

With such savings possible, it is easy to understand why forest managers are willing to spray large areas even though they know that research has not yet obtained the final answer on the optimum amount of chemical and volumes of solution per acre needed to control all of the common competitors. They feel that even without complete kill of the competing trees, enough release will be given to be of great benefit to the plantations.

Almost all spray release being done with aircraft to date is high release, because it is needed more urgently. Low release, however, can also be done effectively from the air. This is shown by the results on a 70-acre plantation of jack pine overtapped by willow which the Minnesota Division of Forestry sprayed last summer. Kill of the willow in late August averaged 80 percent with little injury to the pine.

In view of the large amount of plantation release needed, it is not surprising to find that such work was the main objective on 5,200 acres of the 7,100 acres which have been sprayed from the air for brush control in the Lake States through 1954. Some idea as to the future possibilities of aerial spraying in this field may be had from the estimate that there are about 213,000 acres of plantations in the Lake States needing release, much of which could be done with chemicals applied from aircraft. And this, of course, does not include the release of the large areas which are yet to be planted.

#### Preparation of Brushy Sites for Planting

A second promising field for the aerial spraying of herbicides and one in which some work is being done, is the preparation of brushy land for planting. If brush is killed during mid-summer when its food reserves are at the lowest level, resprouting will be kept at a minimum. Trees planted in the fall or spring following such brush treatment, which is called ground preparation and sometimes pre-release, may, therefore, be brought through with only one other release operation after planting compared to the two or more needed where no prior effort is made to combat the brush.

Heretofore, ground preparation has been done by going over the land thoroughly with a heavy disk. Disking is slow and expensive, costing on the average about \$15 per acre. Furthermore, rough or rocky upland sites cannot be treated nor can the lowland soils. Since aerial spraying is faster and considerably cheaper than disking, it would seem to offer an excellent substitute for the latter in the pre-release of the larger areas of brushy upland. Although no final results from this kind of work are as yet available (a 20-acre tract was aerial-sprayed on the Superior National Forest last July), successful pre-release has been obtained from ground spraying. Hence, there seems no good reason why aerial application would not be just about as effective.

Being unaffected by ground surface conditions, aerial spraying also promises to extend ground preparation to rocky and boggy lands where disk ing is out of the question. For example, we have in the Lake States about  $2\frac{1}{2}$  million acres of peat land on which the original forest of black spruce, tamarack, and other

swamp conifers has been destroyed by logging and fire, leaving only alder, willow, and other worthless brush. If the conifers could be re-established, these lands would again produce much of the pulpwood needed by the paper industry in the Lake States. Hitherto, the lowlands did not appear to be economically plantable, mainly because there was no reasonably cheap method of getting rid of the brush. However, judging from the success in killing lowland brush from the air in 1951 near Effie, Minnesota, aerial spraying may well change this situation.

At the present time, the control of the brush is at a somewhat more advanced stage of development than is the planting. In order to learn more about the planting of swamps, the Lake States Forest Experiment Station is cooperating with the Minnesota Division of Forestry in studies involving about 160 acres of wet land. These areas were sprayed from the air last summer, killing back the alder and willow, and were planted in the fall to black spruce. Additional spruce will be planted next spring to furnish a basis for evaluating spring and fall planting of brushy lowland following spraying.

#### Conversion of Low-Grade Aspen to Conifers

Another field involving planting after spraying herbicides is the conversion planting of low-grade aspen stands to conifers. About 3 million acres of poor-site aspen in the Lake States should eventually be converted to pine forest and thereby enabled to produce a considerably higher return than at present. Hand cutting of the aspen is prohibitive, and disk ing is not feasible in most areas because of the size of the trees. If a satisfactory kill of this species could be obtained with foliage sprays, considerable progress could be made in getting these lands back into pine. Good top kill has been obtained from aerial spraying of aspen in Lower Michigan, but results in Minnesota have been rather poor. Once a dependable technique is worked out, the most likely approach would be to underplant with red pine and a year or two later to spray the aspen overstory from the air with herbicides.

#### Encouraging Conifer Reproduction on Brushy Land

Thus far all of the jobs discussed involve planting or what is sometimes called artificial restocking. Another phase of forest management in which aerial spraying with herbicides seems to have promise is the restocking of stands, particularly conifers, by means of natural reproduction. In Minnesota and elsewhere in the Lake States, large areas have light stands of scattered conifers--spruce and fir--in which the ground is heavily shaded by dense brush or by poor-quality hardwoods which may be mixed with the conifers. Because of the density of the brush or the trees, the few seedlings of black spruce, white spruce, or balsam fir which follow

the periodic crops of seed produced by the older conifers, live for a few years and are then shaded out. Removing the brush or the hardwoods by hand labor in order to give the conifer seedlings a chance to develop would be prohibitive in cost. Frill girdling followed by treatment with 2,4,5-T could be used on the hardwoods but not on the dense brush which most of these stands contain. It would thus do only a partial job and, moreover, is slow and fairly costly.

The promising results shown in plantation release operations have naturally led to trials of aerial spraying as a means of encouraging the successful natural invasion of conifers in these brushy lands. So far most of this work is being done in Minnesota and involves two main types of sites: brushy lowland with a scattered growth of black spruce and tamarack and the so-called "birch-belt" of the North Shore of Lake Superior.

The work in the "birch-belt" is of especial interest for the reproduction problem, the most difficult known in Minnesota, involves about a half-million acres in the state and an apparently larger area north and east of Lake Superior in Canada. The stands typically consist of paper birch, mostly large cull trees, with a few scattered white spruce and balsam fir, and a dense understory of mountain maple, hazel, and alder, in places 15 to 20 feet high. Although this type of stand grows on some of the best forest land in the state, it actually yields but a small fraction of its potential production because of the low proportion of conifers. And once the large spruce and balsam are cut, the prospect of getting natural conifer reproduction becomes even more remote.

Because of the importance of this problem on its own lands, Kimberly-Clark of Minnesota, Inc., aerial-sprayed 140 acres of these brushy lands in early July, 1954. Although it is too early to evaluate the several treatments under test, most of the large birch and much of the brush were defoliated, thus opening up the overstory and giving the few conifer seedlings present considerable light. Results appear fairly good even in the treatment using only 1 pound of acid in 2 gallons of solution per acre. The "birch-belt" brush is consequently beginning to look like a less formidable obstacle to good silviculture in that part of Minnesota.

## Creating Conditions Favorable for Wildlife

A field allied to forest management and one which is often intimately associated with it is wildlife management. Here too aerial spraying is being tested and seems to have possibilities. The Michigan Conservation Department has sprayed over 700 acres of practically worthless aspen in Lower Michigan and in the Upper Peninsula with the hope of killing off these trees and opening up the areas to provide good cover conditions for sharptail and ruffed grouse. On the first of these tracts, 600 acres sprayed in 1952 in cooperation with the Dow Chemical Company, the aspen tops were killed, but the roots suckered heavily the following year. Since the object here is to get rid of tree growth, about 400 acres of this tract were resprayed the past summer. A good kill of the 2-year-old suckers is reported. Along with this work, the Department has also sprayed 225 acres of off-site aspen in various deer yards, the purpose being to encourage suckers which are a valuable deer food. Results are not yet apparent since the work was done only last summer. 5/

### SUMMARY

Aerial spraying with herbicides offers new opportunities to improve forest conditions in the Lake States. Its greatest advantage lies in the possibilities of controlling brush and low-grade tree growth on large areas at a comparatively low cost. The most successful use of aerial spraying to date has been in the release of coniferous plantations from overtopping brush and poor-quality hardwoods. It is also promising for such jobs as the preparation of brushy upland and lowland sites for planting, the killing back of heavy brush so as to encourage natural reproduction of conifers, and the development of better wildlife habitat. Another operation in which such spraying may prove useful is the conversion of low-grade aspen stands to conifers.

Although the research agencies have not yet had time to work out the best techniques for aerial brush control, land managers are doing more and more of this work. Kill of the undesirable brush and trees from this trial-and-error spraying, while not complete, is still good enough to give considerable benefit, and they feel the jobs are worthwhile.

About 7,200 acres have already been sprayed from the air in the Lake States, most of it in the last 2 years. The results of this work plus the research under way in the region should do much to advance knowledge in this field. It, therefore, seems likely that in a few years hand and other methods of controlling brush will largely be supplanted by aerial spraying with herbicides.

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5/ Per correspondence with B. C. Jenkins, Michigan Conservation Department, November 12, 1954.